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NOTICES OF The Aeronautical Society.

A Meeting of the Council was held on Nov. 12th, when the following gentlemen were elected Members of the Society:—

Mr. WALTER BAGSHAW, J.P., M.I.M.E.
Sir JOHN CARDEN, Bart.
Mr. F. W. HEADLEY, M.A.
Mr. C. F. POLLOCK.
Mr. GEORGE L. O. DAVIDSON.

The following members were elected to the Council:—

Dr. L. EARLE, M.D.
Mr. PERCY S. PILCHER.

A Meeting of the Council was held on Dec. 16th.

A General Annual Meeting of the Society was held on Dec. 16th, at the Society of Arts.

B. BADEN-POWELL, CAPT.,
Hon. Sec.

The General Meeting of the Aeronautical Society.

A general meeting of the members of the Aeronautical Society of Great Britain was held on Thursday, December 16th, in the hall of the Society of Arts, Adelphi. Sir Charles Warren, G.C.M.G., K.C.B., R.E., occupied the chair. Among others were present Sir Arthur Blomfield, A.R.A., Commander Tupper, R.N., Major Roberts, Capt. Heath, R.E. (commanding the balloon section), Mr. E. A. Barry, Dr. Earle, etc.

The proceedings commenced with a statement by the Honorary Secretary (Capt. Baden-Powell) as to the satisfactory condition of the Society, and some extracts of letters from Mr. Glaisher and from Mr. Coxwell, expressing regret at not being able to be present, were read. The following addresses were then delivered:

MODEL FLYING MACHINE.

Major Moore,—Ladies and Gentlemen,—The model which I exhibit is constructed in imitation of a flying fox, so as to investigate its powers and means of flight. Flying foxes fly for long distances, and must not be mistaken for flying squirrels. The latter only glide into the air from an eminence. Foxes flap their wings like birds. In flight they make 120 to 180 strokes per minutes with their wings, with an amplitude of no less than 30 degrees, judged by the eye. They travel at the rate of not less than 14 miles per hour. The natural wing of this animal, when examined, is found to be rigid in itself along the front or leading edge, and flexible at the rear edge and tip. In the artificial imitation it is found necessary to reproduce a stay from the wrist to the shoulder joint. This diagram (referring to diagram) is the artificial imitation, and this is the construction, and to get sufficient strength I had to introduce a stay from this point to this point (indicating). In the first models made with these wings, clock springs and electro-motors were used to work the wings. When they were flapped, the wings gave a powerful driving and lifting force in the down-stroke, but this effect was more or less destroyed for obtaining flight in the up-stroke. To overcome this difficulty, I went to nature for further information, and in my next design I introduced springs to represent the pectoral muscles.

Muscles act like springs. They expand and contract when excited by an electric current, and so perform work. In

this way the pectoral muscles worked the wings. With springs fixed to the wings in the same position as the pectoral muscles, the weight of the body can be balanced against the leverage of the wings as when on the air. In this (referring to model) you will see I have springs here which balance these wings against the weight of the body. The point of attachment is believed to be the point of non-oscillation in all natural wings when the flying foxes or birds are flying in the air. In this diagram here, this is the point of non-oscillation, and is where the pectoral muscle in nature is attached to the humerus. By watching large birds carefully, it may be detected by the eye that there is a slight rise and fall in the body to alternate with the down and up stroke of the wings. This is shown to be what takes place in flight, both by Marey and Headley in their books. The body rises and the wings fall. By hanging the model at the points of non-oscillation, and straining the wings as when on the air, the motion for flight, as in nature, can be imitated mechanically by actuating the springs. If I suspend it at this point of non-oscillation, by actuating these springs, I can imitate the action of the wings as in nature. (Illustrating by model.) By an arrangement shown in this model a current of electricity can be made to operate the springs and make the wings flap. This I have frequently done in my studio, where I have a current and suitable arrangements. There is a difficulty in exhibiting that in a lecture hall. I should have to have an electric battery and larger wings than these to exhibit it properly. In nature the nerves take the place of the wires. The motor and springs may be likened to the muscles, the contact maker and breaker to the brain. In this model there is a small contact maker and breaker which acts on the current, and alternates this and so acts on the springs. The effect of working the wings when suspended is to produce a strong current of air in the down stroke which drives the model forward forcibly. We know from what Marey says at the conclusion of his laborious experiments, that it is this force produced in the down-stroke that effects flight.

In the case of this model, which weighs only 3 lbs., the strain on the springs is 57 lbs. or 28½ lbs. on each spring on each side. Special springs must be selected for the particular strain for any sized wings, as this would vary in every case. They must be tested practically with their load to give by their natural resilience and the right number of strokes and amplitude for the wings without being over-strained when actuated. Springs have a natural resilience varying with the load on them and their length. I have some springs here (illustrating). I have one spring, and another double the length. That spring (the longest) if I actuated it, gives a certain number of oscillations per minute. Those oscillations are 132 per minute. Well, now, if I hang this same weight upon the shorter spring, I get 200 oscillations per minute. I can do another thing. I can hang a lighter load on, and after a while I get 200 oscillations per minute. It would take too much time to count them; you must take my word for it. The number of strokes per minute for any particular spring and load is not effected by the amplitude. This depends upon the force exerted to actuate the spring. The work to produce flight is that necessary to actuate the springs when strained with their proper load, as when the wings are on the air. The wings must make the right number of strokes per minute, and be of sufficient amplitude. In the case of the flying fox, the strokes of the fox when in full flight, average 144 per minute. The amplitude is taken as not less than 30 degs. The power necessary increases on a sliding scale in the case of larger machines. For a fox the weight of a man the power required works out 1 h.p. for 125 lbs. Maxim, with his small experimental models, driven by a screw propeller, found that 1 h.p. was necessary for every 133 lbs.; but with his larger machines he only flew 22 lbs. per h.p. Wings are probably more efficient for driving than screw propellers, as there is a great loss of power by slip with the latter; also wings move a larger weight of air due to their spread with a slower motion than could be the case with the screw propeller.

As regards the making of a practical machine for flight, I am keeping the length of the wings in my design down as much as possible, without unduly reducing the area. For this reason I have two or more pairs of wings instead of one pair only. These I arrange in tandem to give longitudinal stability. For the motor, I intend to have one which need exert power in a vertical direction upwards only. It would be a simplification of a kind used for cycles, and can be much lighter. Lately a lot has been done with soaring or gliding machines. If the wings for these were made strong enough, as they could be by following my designs, springs could be added to them. These would enable a man to more or less flap the wings when gliding, and so ob-

tain a driving pressure. This is an experiment I should like to carry out if I could see my way to it.

The solution of the problem of flight is one surrounded by many difficulties, but if all those interested in the subject will combine to help its solution forward with reports on the results of their practical experience, there is little doubt it will be successfully solved in time. (Applause.)

BALLOON SIGNALLING APPARATUS.

Mr. E. S. Bruce,—I have on several previous occasions had the honour of bringing my system of electrical balloon signalling before the notice of this Society, and I have described pretty fully the different experiments I have conducted for the various Governments that have adopted the apparatus for the purposes of warfare. With the progress of time another use has arisen for electrical balloon signalling. It promises to be a valuable adjunct to scientific exploration in Arctic and Antarctic expeditions. In Polar expeditions the want of intercommunication is perhaps one of the most depressing deprivations which befall the explorer of the untrodden latitudes. In Dr. Nansen's recent expedition the want of some point of communication between the drifting ship and a party of explorers leaving the ship even only for short excursions was severely felt. If the crew of the "Fram" had had the means of raising a light high above the mast tops to some thousand or even five hundred feet, and moreover if this light could have been made to flash signals it would have acted not only as a beacon guide, but also as a means of communication to any party that had left the ship, telling them whether the ship had recommenced to drift, the direction of the drift, or any other news that might have been welcome. Much assistance would be given to any Arctic exploration by any system of balloon signalling—a model of which I have on the platform. I may mention that in adapting this electric balloon to Arctic wants I have introduced some slight modifications in the apparatus. I have hitherto made my balloons of thin varnished cambric. For Arctic work, however, I have selected another material—gold-beater's skin—of which that model balloon is made. I have selected gold-beater's skin on account of its lightness. The cambric signalling balloon I made for use in war had a diameter of 14 ft., and a cubic capacity of 1,600 ft., and this took to fill it about 14 tubes of compressed hydrogen, these tubes being about 8 ft. in length and about 8 ins. in diameter. Now the smallest practical signalling balloon made of gold-beater's skin would be 7 ft. in diameter, and it would have a cubic capacity of about 150 ft., and it would take a little over one tube to fill it, as compared with the 14 tubes to fill the cambric balloon. An Arctic explorer would probably have a balloon a little larger, with a little more lifting power, so as to get greater altitudes if he wishes—perhaps a 9 ft., or even a 10 ft. balloon. The apparatus consists of a balloon, in the centre of which there are several incandescent lamps. These are in connection with an electric circuit on the ground, and on the ground there is an apparatus for making and breaking contact rapidly. It is something like a Morse key, such as we use for telegraphy, but it is essentially different, an ordinary Morse key would not stand the currents necessary for lighting the electric lamps. They have two forms. This is the form I have supplied to the British Government, and I consider it is the best form of key. The Belgian and Italian Governments are now adopting my system, and using this latter form of key. If I depress the key, the lamps in the globe become illuminated, and by depressing long or short we can make signals thus (illustrating). There is an apparatus or switch by which the light can be turned continuously on to the balloon, so that it might be used to act as a beacon light to any party who wanted to know the position of the ship. I may mention that a second use has been found for the electric balloon lit up in that way. It has been sent up a short distance from the ground, about 20 ft.; it gives a diffused light over a large area, and it is found possible to carry on work by this light. Perhaps in Arctic work it might be used for the same purpose. They might send the balloon up if they wanted to dig a ship out of the ice, or anything like that. That is a secondary use, but it shows what a diffusion of light we can get by placing the lamps inside the balloon. Besides being useful from the decks of Arctic ships, it would probably be very useful at Arctic stations, which are now becoming a prominent feature of Arctic expeditions. In the case of that carefully planned and scientifically equipped expedition from the Station of Elmwood, if such a balloon as this had occasionally arisen from that station there is no doubt Dr. Nansen would have been aware of the presence of friends long before he heard that welcome dog-bark. (Applause.)

KITES FOR LIFE SAVING.

Mr. Speirs,—My father has requested me to act in his stead, and to explain our model. It has been his object, if possible, in the case of shipwreck, to get a suitable and effective apparatus that will carry a line to the shore without the crew of the shipwrecked vessel awaiting assistance from the shore. And after considering all the possibilities of such a case he has come to the conclusion that the kite is the most simple and effective means. With that view, he has constructed a very simple arrangement, as you see—an oblong kite with pockets at the corners to fit in two cross pieces. It takes about one minute to fix the kite up. From the top corner to the centre is fixed a bridle, to which the kite line is attached. When a vessel goes ashore on the lee shore, anything blown by the wind would eventually reach the shore. The whole apparatus is contained in a box which should be carried at the most convenient part of the ship, say on the flying bridge, so as to least obstruct the lines in travelling out. The kite line is held on a small drum, and a stronger, or hauling, line is contained on a second drum. The box itself is on a pivot, to allow free action to the wind. Now, assuming that a vessel has struck, and we wish to make communication with the shore. We will fit the kite together, and attach the kite line to the bridle of the kite by means of a toggle holding its surface to the wind, and it would eventually find its way. Each of the drums is fitted with a brake by which we can regulate the revolutions of the drum. Should the kite fall short, the man would simply check the brake, and the kite would rise again until eventually it reached the shore. Well, in paying out, the kite line being fitted with a small toggle, in its turn catches up a stronger line which would be conveyed to the shore. On the end of the second or hauling line you see there is a small toggle fitted on, and on to the side of the box there is a lead attached which insures the paying out of the line. Whilst the shore line is paying out, you take the ship end of the hawser and make it fast to the most suitable portion of the ship, either a mast or a staunchion. The first man can then step into the breeches buoy and start for the shore. As regard life saving that is all I have to claim for it. Then there is, secondly, communication between two ships in mid-ocean. Only a few days back a liner passed a vessel in a sinking condition, and with great bravery the boat's crew put off and rescued the crew of the sinking vessel. But circumstances might have been far different; the weather might have been boisterous, and it might have been sheer folly to send a boat out. Our contention is by getting to the windward we could get a line aboard, and fix up a hawser, and get that crew from the vessel that requires assistance without necessitating the risk of sending a boat's crew from the vessel. Then again there was an instance some little time back where a lighthouse keeper was sick, and needed a bottle of physic to put him right, and he signalled to that effect. However it was not forthcoming; and although they tried to go to his assistance, they could not effect communication. Now if we could only have got a line there, we could easily have sent a bottle of physic or a doctor to follow it. Another way in which it might be useful is for picking up a hawser from a tug, if a hawser wore out and snapped aboard a vessel which was suitably equipped with a kite, and there would be no difficulty in making communication with our apparatus. (Applause.)

The Hon. Secretary then read some extracts from a letter he had just received from Admiral Sir Arthur Cochrane, who said that he had written a letter to the "Times" in 1872, referring to kites as a means of communication with wrecks. The following extracts were read:—"During the Russian War in 1855, and when in command of a frigate, I was desirous of ascertaining whether vessels and forts in the sea, which were unapproachable by ships or boats, could be injured or destroyed by means of torpedoes, towed into contact with such bodies by means of kites. With this view I made numerous trials with large 12 ft. kites attached to floating bodies such as planks with percussion firearms upon them. The kites were flown as directly to windward of the ship to be struck 'as due allowance for the deflecting action of the tide would permit,' and, at a distance from it of about two miles, such was the accuracy of the course of the kite towing its torpedo that it struck the ship, or otherwise would have proceeded to sea, and the speed of the kite was so great that, though pursued in a powerful six-oared galley, under oars and sail, it could not be overtaken, nor did the kite 'run down.' These trials forcibly impressed upon my mind the immense advantage which might be derived from the use of kites as a means of towing manilla rope hawsers to the shore from ships, with a view of communication, and for towing persons to the shore from stranded ships. Many people, when shipwrecked, throw themselves into the sea, holding to spars, and are mostly drowned through being

washed to and fro by the backwash of the waves.

"Were they, however, to attach themselves to a kite rope, and so be towed to shore, a few moments would suffice to land them on the beach, where they could be promptly rescued. The crews of ships aground under high cliffs, 'having no beach' look upon their fate as hopeless; but by means of kites, ropes could be, so to say, carried to the top of the rocks and communication established. All merchant ships should be obliged to carry a certain number of kites. 'These can be made of many forms: conical, triangular, etc., and without tails,' having steel or wood frames with the canvas and rope attached ready for use. The practical methods of employing such kites would suggest themselves to all, if their use was authorised and enforced. In our training ships for boys for the mercantile marine, the art of skilfully using kites for such purposes, and the employment or handling of life-saving apparatus at sea generally, could be taught."

KITES.

Capt. Baden-Powell,—I think most of you are fairly well acquainted with the general system that I have been employing for utilising kites, especially for man-lifting purposes; but there are some of you, if not most of you, who have not actually seen the apparatus, and therefore, I have procured one of my kites to-night to give you an idea of its make. You will see it is very simple, merely three poles and a more or less hexagonal-shaped cover. Here is a small model which shows you the method by which it is flown. You see here (indicating), there are two strings. I usually employ two if there is any necessity to make the kite fly steadily, that is during strong puffy winds, and for man-lifting I prefer two strings, because it makes the kite steadier, and, therefore, better for observation purposes. In calmer weather, however, one string is often sufficient, because the wind is then steadier as a rule. I have often been lifted to a considerable height on a single line kite. I won't go at all deeply into the subject now, because as far as general principles go I have already explained them pretty fully, and as far as the theory of the subject goes, I am preparing a paper to read in this hall early in February, which will go as deeply as I am able to go into the theory of kites and the practical working of them. Kites seem to be coming to the front more every day. In America great progress has been made; not only has the Weather Bureau of the United States adopted them for systematic meteorological observations, but also in the United States' Army, important man-lifting experiments have been made with most satisfactory results, and now I hear that experiments are about to be undertaken in the German Army with kites. It seems a pity that they could not have been used in the recent fighting in India. I have received a letter from an officer out there who is strongly of this opinion. An elevation of a few hundred feet would be most valuable to look out for detached bodies of the enemy, especially when they are posted about among rocks, and in places where they are difficult to see, when you are on the same level or below them. It is possible that, if they had had some method by which to overlook these parties, many lives might have been saved in this recent war. I hope during the next few days to have some more trials of my apparatus in the neighbourhood of London, and shall be very glad for any member of the Society to come down and witness them.

You can see now from these kites that it is a very simple form of apparatus, and you can also see how light they are. A kite like this one, which is 12 feet high, only weighs from 5 to 7 lbs. They vary slightly. I had some specially made light for light weather, and others made very strong for strong winds. As a rule four or five of them are sufficient to lift a man. I have tried as many as eight together; in calm weather it requires that number to lift a man. On the other hand, in very strong winds indeed, I have known one of these kites lift me off my legs. To this little kite I have attached a piece of paper in order to show the method by which the man is suspended from the kite. It was only suggested to me just before the meeting, when I was asked: "Are you strapped on to the kite?" This will give you an idea. There is a car hanging from the lines similar to a balloon car, and in that the man is practically comfortable. I generally use an open parachute over my head in case of the lines breaking or anything going wrong with the kite. Well, I think that is as much as I need tell you about kites at present; but I shall be very happy to show you any details afterwards, and you can examine the kites themselves. (Applause.)

SOARING MACHINE.

Mr. Pilcher,—Better than describing a soaring machine, I must ask you to look at the one overhead; that is the one I have done best in. The other day I cleared nearly 300

yards in it. Now the object of these soaring machines, or rather the use of them, is to learn how to manage the simplest and cheapest machine in the air that can possibly be made. They are flying machines without any engines.

How do you fly without power?—Well, you either get up at the top of the hill, you face the wind, take a run, and then slide off into the air, and make a decent landing if possible at the bottom, which require practice; or else, which is a rather more difficult proceeding, get up to the top of one hill, with a string stretched across a valley to the top of another, and are towed straight across the valley through the air. Now this machine takes a pull of between 20 and 30 lbs. to keep it in horizontal flight with me in it; and I weigh about 140 lbs., the machine is about 50 lbs., that is 200 lbs. To keep that in horizontal flight with 20 lbs. pull, means a pull of only about one-tenth of the weight of the machine.

Mr. Moy,—How many square feet?

Mr. Pilcher,—This one has 170 square feet, that is about 1.3 lbs. to the square foot. How do I hold the machine? There are some photographs here which shew the thing pretty clearly. I get into the soaring machine simply by slipping my forearms through those padded straps. Then I hold on to the two handles, so that I am simply supported on my elbows. I keep the machine well back on me when I am standing, so that there is too much sail behind and the wind simply spills the sails and does not lift me. If when standing thus, holding the machine well back, a puff of wind comes, and as it comes the apparatus is brought forward, the wind will lift one up. I have in this way, without running at all, been picked up 10 or 12 feet from the ground, and put down in exactly the place I left, without having any line attached, being perfectly free. A little work has been got out of the puff of wind, possibly also the wind had an ascending trend at that particular place. Many people argue that some of the birds manage to get work from the wind continually. The great difference between a human being and a bird is that we are most misshapen things for the purpose of flying; we expose an enormous frontage to the wind, whereas a bird is nicely shaped away; although I am rather proud of these machines, they are not nearly as smooth and nicely finished off as birds are.

Mr. Moy,—Have you tried the super-posed plane?

Mr. Pilcher,—I have a machine with super-posed surfaces in hand. I think single surface machines have been abused more than they deserve. I think I can do just about as well with a single-surface machine as has been done with the super-posed surface machines, that is to say, with one surface placed on top of another so as to keep down the dimensions of the machine. Lilienthal first introduced this type of machine about three years ago; he allowed me to fly in one of these machines of his. I don't think they promise to be any better than single surface machines. The great objection is that if with engines you lose forward speed in the air, the parachute action is very much less, and one will take a much more sudden dive before recovering forward motion. The great thing is to make a decent landing. When I have been going along quickly, I have broken this machine several times by not landing properly, that is to say, by touching the ground when I have had a big forward speed. In this machine I took the precaution to put these little wheels underneath, and they take a great blow. If they break, the bottom of the masts get into the ground, and the next thing that happens is—well, the thing turns over endways, and gives one a bit of a jar. The proper thing to do is to get well back into the machine; that is to say, you put on the brake very slightly, you cannot put it on quickly. You see that rudder behind; without that rudder you cannot handle the machine at all; it is much too slippery, it will go down in front, and then it will rear up, but the horizontal rudder being slightly raised makes the thing very much steadier, it keeps the machine from pitching suddenly. The thing to be afraid of is taking a header. You are not nearly so likely to go back the other way, though it is possible. Lilienthal once got too far back in the machine, lost his balance, and then had a bad accident. The little vertical rudder has a little bit of a weather-cock action. If the wind suddenly shifts, it swings the machine round to head the wind.

How do you steer the thing?—If you want to turn in the air you get on to that side of the machine towards which you want to turn; that is to say the machine will always turn towards the lower wing. If the wind shifts, and you get a puff from one side, get right over to that side so that the machine will turn that way and tend to head it. When you are once off in the air, it is the relative wind you feel; I mean the wind made in relation to you, not the real wind. Now I started this game about two years and a half ago. I had been working with Mr. Maxim for

some length of time, and I had some accounts of Lilienthal's experiments in Germany, and I thought they would be most interesting to try and copy, and to try and proceed further with what he had done. Unfortunately about a year ago he came to grief, and so I have been trying to do justice to him as a pupil—(laughter)—not in coming to grief, I hope.

This machine is made so as to fold up; you cast off these, and the whole thing folds backwards, and you can then wheel it about without much trouble. One sail goes one way, and the other the other the other, and it will then go into a comparatively small crate.

Again, what is the object of these experiments with soaring machines?—Simply, as I said, to learn to handle the cheapest and simplest machines in the air—a machine which if it breaks does not really matter much.

Now that I have learned to handle one of these thing more or less, I have got an oil engine in hand of about 4 h.p., which I think should be enough to keep me in horizontal flight. The pull on a line attached to the machine is between 20 and 30 lbs., the speed at which the machine floats is about 20 or 25 miles an hour. If you multiply that out you come to about 2 or 3 h.p. Consequently, I have been intending simply to put a screw propeller, driven by an oil engine, into the machine, and I hope in time what are now soaring machines will develop into bona fide flying machines. In this machine the screw would be placed behind me, that is to say in front of the rudder, in the after part of the machine, but right above the ground so that it cannot get injured. The engine would be placed in the front, and the shaft pass over my head. I am not quite sure whether I shall put the engine in this machine or in another; but not a larger machine. I cannot handle a larger machine; it gets too cumbersome. If we put a greater weight into the machine of a certain size, it only means that to float it you will have to sail faster: a limit has to come in somewhere. I have tried various machines, from 150 lbs. to 300 lbs.; but I find about 170 seems to be about as much as one can handle—otherwise a little bit of irregularity in the wind throws one all over the place.

Mr. Moy,—You will have an additional weight in the machine, therefore.

Mr. Pilcher,—The propeller does not weigh much—3½ lbs., and the oil engine will weigh about 40.

Mr. Moy,—I understand that Mr. Chanute is doing the same thing in America.

Mr. Pilcher,—Yes, Mr. Chanute told me he did not want to go on with an oil machine until he had done more experiments with the gliding apparatus, although Mr. Herring, who is now working with him again, particularly wants him to do so. They have had an oil engine, but they have had a little trouble in trying to get it to ignite. The screw is 5 feet in diameter, the pitch is about 4 feet, and about 3 ft. 6 in. in the centre. It is made of yellow pine, and covered with canvas, and is exceedingly stiff and strong. This machine, with the screw propeller and engine, would become a Maxim type of machine, the smallest possible kind to carry a man. I look upon it as a mistake to make anything bigger than one can possibly help, because the weight and expense, and the danger, and everything else seems to me to increase with the increase in size. (Applause.)

GLIDING MACHINE.

Capt. Baden-Powell,—This little machine you see here is a very small and roughly made apparatus compared with Mr. Pilcher's; but this is made with rather a different object. I wished to try for a certain result. When you are gliding down a hill with one of those machines like Mr. Pilcher's you are suspended in the air for a certain time, it may be only a few seconds. I don't know whether Mr. Pilcher has ever timed it, but sometimes one can, I believe, go on for about fourteen seconds. I wondered what would happen if you were propelled along by the wings. I therefore made this apparatus smaller, because I do not want to remain in the air fourteen seconds; it would do for my purpose if I could be there two seconds, that is to say, if I could run down a hill and give a jump and a couple of flaps of the wings, and in that way I should be able to get an idea of the effect of flapping wings as a propeller. But as a matter of fact I have not had any satisfactory trials with this machine. I only tried it once and found various little defects in it. I thought I would bring it here just to show you the general idea of the thing. I have some photographs here showing the method by which it is worked.

AN ALUMINIUM BALLOON.

Captain Baden-Powell,—I recently received a communication from Captain Moedebeck, a German artillery officer, in which he gives a very interesting account of the aluminium balloon. I daresay many of you have seen

accounts of it in the papers. This balloon went up in Berlin, and apparently came down very quickly, and they say the man who was working it only saved his life by jumping out. It sounds a curious way of saving his life, but that is what the papers tell us. It seems to be very doubtful whether it was a great success or a great failure. Captain Moedebeck says it was a great success; I will therefore just read some extracts from his account*.

The Chairman (Major-Gen. Sir C. Warren), —Ladies and gentlemen,—Before closing the proceedings this evening, I propose to make a few brief remarks. Before Mr. Pilcher gave his reasons for experimenting with these flying machines, which he has developed to such a great extent, I began to be filled with gloomy apprehensions as to our future domestic life. If persons are to be able to put on wings and fly about freely in all directions, we shall have to live like birds, in cages—(laughter)—we shall have to have a network put over our windows and gardens and orchards, to keep out the flying men of the future. But it does not appear that the work is going in domestic directions; the tendency is to develop the aerial machine rather in the direction of military science, and in regard to saving life. Now with regard to military matters: I think I was the first general officer to ascend in a balloon on active service. I took a balloon equipment to Bechuanaland in 1884, and I should like to say a few words on the subject to show you how easily the matter is arranged. The gas required was packed in steel tubes under great pressure, and the waggon containing this gas and the balloon was brought right away up from Cape Town by the railway to Hope Town, and then by waggon into Bechuanaland. When we arrived at Mafeking, where the experiments were made, we were about 4,000 feet above the level of the sea. The balloons were not originally constructed to ascend more than 6,000 ft., so that we had only the limits of 2,000 feet, and not even that with a heavy man. In going up in the car I found the balloon spun round too much for good observation of the country. Afterwards, when other experiments had to be made, I went up in the net without the car at all, and I took up a telephone with me—it was rather a heavy one—in order to communicate with the land as to the whereabouts of an enemy we were looking for; but the weight of the telephone prevented my using it successfully without the car. This military question of using the captive balloon in warfare, and sending down intelligence is an important point.

Then with regard to kites. To my mind it is a matter of great importance. They were used by Captain Baden-Powell in the New Forest manœuvres about two years ago, but unfortunately he was on the side opposed to me, and I had not any opportunity of securing his services. We were obliged to use high trees. I saw afterwards the work that was going on, and also I saw his work at the British Association at Norwich in the following Autumn, and I formed a high opinion of the usefulness of the invention. He has described it partly to you. The rope was first laid out and then the kites were attached. A man got into the car, and he was allowed to go up with a parachute above him, so that in case of the rope breaking he could break his fall by means of the parachute. I may mention that there were a great many men in the crowd who went up in the kite car one after the other, and they were taken up from about 50 feet, quite high enough to get an extensive view over a flat country. It is of the greatest importance sometimes in a military campaign that we should be able to get up to a height of 40 or 50 feet. I think really the question of these kites deserves encouragement, and Capt. Baden-Powell deserves very great credit for the perseverance with which he has carried out these experiments. He has practically overcome many of the difficulties that he has had to encounter, and kites can now be used practically for military purposes.

Then with regard to the balloons for signalling. I think it is of great importance that they should be fully developed and brought into the service. I am quite sure it would be of the very greatest use to us. You must all have seen also the importance of the other apparatus for life-saving. If an arrangement of that kind could be put into practical use it might save the lives of scores or even hundreds of sailors. (Applause.)

On the conclusion of the addresses, the members and visitors had an opportunity of inspecting the various exhibits arranged round the hall. Mr. Pilcher's great soaring machine was suspended over the centre of the hall. Captain Baden-Powell's smaller apparatus, simply consisting of a pair of bird-like wings of cloth stretched on a bamboo framework, stood against the wall at the back. Major Moore's neat-looking silk model flying-fox was to the right of the platform, and Mr. Bruce's signalling balloon occupied one corner, with Capt. Spiers' life saving apparatus near it. Capt. Baden-Powell's large kite was on one side of

* *Vide* page 11.

the room. To the left of the platform was the "Aeroscope" to show the course of currents of air impinging on plane and curved surfaces. The current of air is drawn up the tube by an electric fan driven by a Cox Generator. This latter instrument attracted some attention, it having been kindly lent for the occasion by the Cox Thermo Electric Company of St. Albans. In principal it is but an enlarged thermopile, which being placed over a gas jet or spirit lamp, gives forth an electric current of 4 amperes to 3 volts, and seems to form a most handy and cleanly method of obtaining electricity, eminently suitable for all experimental purposes.

A large artificial feather was also exhibited, which practically illustrated the great amount of resistance to be obtained from the air, when violently struck by such a surface. Many photographs were also shown.

A vote of thanks to the Chairman and to the readers of the papers terminated the proceedings.

Some American Experiments

By O. Chanute, C.E.

Probably few readers realize the advance which has been made towards a practical solution of the problem of aviation within the last eight years. It is greater than all that was accomplished during the preceding two centuries. Not only has the subject been rescued from the contempt brought upon it by past failures and eccentric proposals, but very able men—Langley, Maxim, Pilcher, Hargrave, and Lilienthal—have shown by their experiments and writings that man may fairly hope eventually to fly through the air.

Hundreds of failures during the last 300 or 400 years have well shown what arrangements will not answer, but the labours of these latter experimenters now enable us to forecast that success is most probably to be won with aerocurves, driven by screws or flapping propellers, actuated by a steam or a petroleum engine.

What is the best course to be now followed to make still further advance? Most of the above experimenters seem to have proceeded upon the assumption that it is practicable to evolve a complete flying machine at one operation, and to apply propellers and motors from the first, before we are quite certain as to the stability in a wind. I venture to differ from them in opinion, and to believe that it is better to divide the evolution of a dynamic machine into several stages; that is, first to solve thoroughly the problem of the equilibrium, under all conditions of flight and of wind, before complicating the question by the addition of an artificial motor. In other words, that safety and automatic adjustment must be secured in the air, with a full-sized machine carrying a man, actuated by the force of gravity alone, before any other power be applied. Full-sized experiments are clearly the most fruitful; they have been few, because of the danger involved, and yet Lilienthal showed by thousands of flights, until the very last in which a hitherto hidden defect brought disaster, that the safest agent of propulsion was gravity, and that the danger was greatly increased on the one occasion on which he attempted to add a motor.

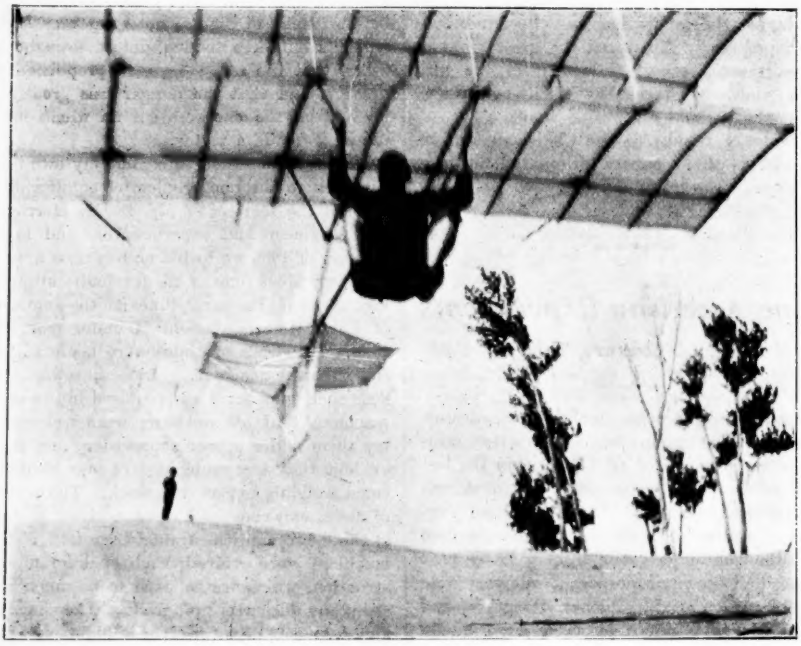
Having determined to confine my own investigations to the one problem of equilibrium, I secured the services of Mr. A. M. Herring, a civil engineer and experimenter, and in the summer of 1896 we tested no less than five full-sized machines (one of them rebuilt) in gliding flights among the sand dunes at the south end of Lake Michigan, about 30 miles from Chicago. Hundreds of glides were made without the slightest accident. Indeed, towards the last, such confidence was acquired in two of the machines that all amateurs were welcome to try them under proper supervision, and it was evident that any young, active man could become a gliding expert in a week. The account of these experiments has been given in detail in the "Aeronautical Annual" for 1897*. Two machines were evolved, each of different construction, which are believed to be much safer than any hitherto produced. They measurably take care of themselves in flight, and tend to restore the equilibrium automatically whenever compromised by the wind. This is done in both constructions by reversing the principle of the Lilienthal apparatus, in which the man has to move to bring back the centre of gravity under the centre of pressure, whenever the latter shifts from any cause. In the new machines moving parts are provided to actuate the supporting surfaces themselves, or to change their angle of incidence automatically, so that the operator shall only intervene to do the steering, or to alight. It is not claimed that either machine is as yet fully perfected, and that the man does not have to move at all,

* "Aeronautical Annual," edited by Jas. Means, Boston U.S.A.

but the frequency and amplitude of such required movements have been greatly reduced, and it is hoped that they will be eliminated altogether.

The "multiple-wing" machine, so called, consists in four pairs of wings, superimposed and rigidly connected by bridge trussing. They are fastened at their roots to vertical rods, rolling upon ball bearings, which are attached to the central frame, so that the wings on each side may swing horizontally forward or backward, their movements being controlled and rear of which is attached a horizontal and vertical rudder, the whole being provided with a regulating mechanism designed by Mr. Herring, the operation of which is such that when the direction of the relative wind changes, the apparatus alters its angle of incidence, and thus restores the coincidence between the centre of pressure and the centre of gravity. This machine made the longest glides.

Fresh experiments were made in September, 1897, in the same locality, with a machine built by Mr. Herring for an



V.—OVERHEAD.

limited by springs. The object is that the operator shall remain in one fixed position, and that in case the direction of the relative wind changes, the wings shall automatically move to bring back the centre of pressure directly over the centre of gravity. There is another pair of wings at the back, with elastic rear surfaces, which acts as a horizontal rudder. The supporting surfaces measure 143.5 sq. ft., and the total weight is 33½ lbs.

The other machine was termed the "two-surfaced." It consists in two aerocurves rigidly connected by bridge trussing, to the amateur, and again hundreds of glides were performed without the slightest personal accident. The novice did manage to injure the machine slightly once (repaired in 10 minutes), but he made quite a number of longish flights with no harm to himself. The machine was of the two-surfaced type, equipped with the Herring mechanism, and the photographs herewith reproduced, although each taken from a different glide, fairly represent the various phases of a single flight.

Fig. 1 shows the apparatus at the top of the sand hill, which is about 50 ft. high, and the

operator is creeping under, so as to place himself within the arm bars when the machine is lifted up. The apparatus is designed upon the principle of superimposing the surfaces, proposed in 1866 by Mr. Wenham, and the frame consists in a bridge truss, with vertical posts of spruce wood and diagonal wire ties, capable of sustaining safely about 400 lbs. at the centre. The length across the wings is 16 ft., and each is 4 ft. 4 ins. broad, curved to a concavity of one-tenth of the width. The sustaining surface is 131 sq. ft., and the total weight is 25 lbs.

Fig. 2 shows the apparatus poised in the wind, preparatory to a glide. This operation involves some dexterity and experience, as the winds buffets the operator, and tends to lift him up prematurely. This is avoided by keeping the front edge slightly depressed until the moment of springing into the air, which occurs after two or three running steps have been taken. When this has been done, the man is off, as shown in Fig. 3, and glides over the ground at about 15 to 40 ft. per second. If the operator has assumed the proper position on the arm bars, the regulating mechanism takes care of the fore and aft equilibrium, but if a wind gust strikes under one wing more than under the other, thus raising it up, the operator has to restore the balance by throwing his weight (the feet in this instance) towards the side which has been elevated. Fig. 5 shows the machine sailing along directly overhead of the camera. The glide continues nearly parallel with the slope, until the bottom of the hill is reached, and the headway stopped, as instanced in Fig. 4, by tilting the machine up at the front, when the operator alights upon the sand with almost no jar at all, generally having glided about 300 ft., at an angle of about 10 degs. Then the apparatus is carried back, to make another glide, for the sport is so fascinating that experts can hardly get enough of it.

These experiments are believed to set forth that the objections which have been raised to superimposing concave surfaces, and to placing the operator so low beneath them, are not well founded. It is thought, however, that with such an arrangement the apparatus must contain within itself some moving mechanism to restore the balance as fast as it is compromised, and I am beginning experiments with still a third method of accomplishing this object, not because the two already tested are not satisfactory, but because it is deemed more prudent to endeavour to evolve the very best method before a motor is applied.

The German Aluminium Balloon.

By Capt. MOEDEBECK.

(Translated from the German.)

In most circles, particularly amongst technical aeronauts, the opinion is widespread that the adherents of construction of aerostatical dirigible balloons are on a false track, and that their objects are fundamentally different from those who seek to solve the problem of flight by purely dynamical means. The great resistance of the air which the balloon has to overcome, and the unfavourableness of such a form of construction, is generally put forward as an insurmountable obstacle.

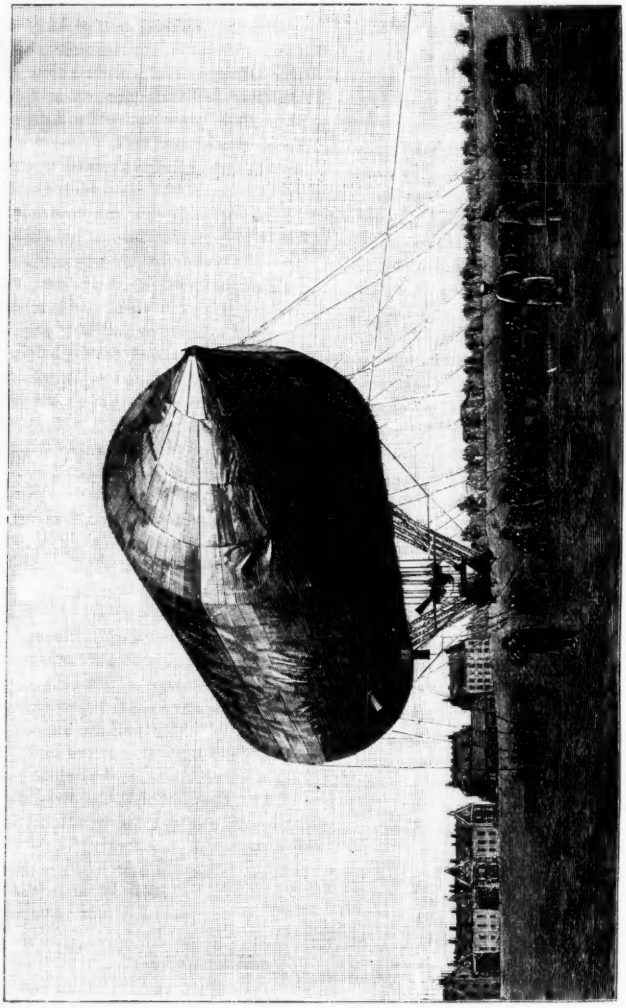
The balloon, as all must allow, has already gained a recognized position, and has become useful for military and scientific purposes, whilst the dynamical flying machine has proved that, with such modern technical ingenuity of construction as has been created by Maxim, and is represented by the first flying machine to carry three persons, anything may be expected of it in the future.

This belief in the future of the dynamical aerial machine is shared rightly by all aeronauts, but the development of it can only proceed (in the opinion of all practical and experienced balloonists) through the aerostatical balloon. The latter is an inevitable step in the evolution of aerial navigation. It represents to a certain extent the swimming belt for the aerial swimmers of the future, being provided with which they can learn to know the peculiarities of their aerial element, and find out how they have to behave in it. That supposition is also not right which some aeronauts hold, that an infallibly dirigible course can be kept by the balloon in almost any wind.

Practical aeronauts, as is often professed, have been content with a moderate speed, under the conviction that they would attain great results, provided only that they could, during hours and days, give to their vessel an independent motion.

One must quite give up the idea that a balloon could at once, like a railway, take up regular traffic. Such ideas are fancies which fly far beyond a reasonable limit. Given an independent motion of 8m. per sec., and our knowledge of the air currents are quite sufficient to make a useful scientific, as well as military, vehicle of the balloon. Certainly no one can fail to understand that as soon as

practical experiences are placed before us, improvements will follow naturally. Were we to enquire whether the dynamical flying machine corresponds to such requisitions, we must answer "No"; and in these days you would not even find an aeronaut who would risk himself in a vehicle exposed to such quite unforeseen casualties. It is quite the other way with the balloon. It represents a vehicle of which you can make use from the first. A proper motion of 6.5m. per sec. has already been reached (1884-5), but as the electric motor was only working for 20 minutes, the balloon which Capts. Renard and Krebs constructed was nothing more than a preliminary experiment. We now know that with our light motors we can easily reach that proper motion (6.5) during 10 or more hours. We think we may bring up the proper motion to 8m. per s., and hope to raise it in the end to 10m. per s. (equal to 22½ miles per hour), or even higher.



THE GERMAN ALUMINIUM BALLOON.

There would be no difficulty in obtaining the necessary driver and attendant in this case. The considerable number of well-trained aeronauts which Germany possesses would hardly refuse to welcome a balloon concerning which

all eventualities have been thought out, and ensured against, and, after repeated trials, to man it.

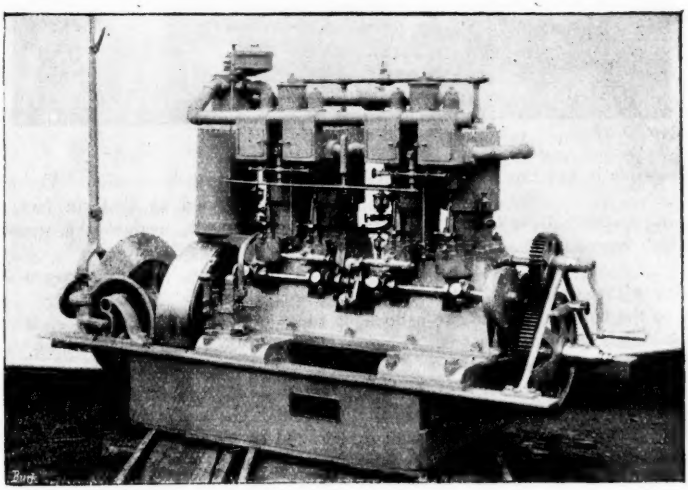
It will at once be clear to anyone what a prospect to balloon propulsion, and all the problems connected with it, opens up. In order to further the practical construction of an aerostatical balloon in a way which would answer the purpose, a memorable and interesting trial of a balloon, made entirely of sheet metal, took place on November 3rd, 1897, in the afternoon, between 3 and 4 o'clock, on the Tempelhof field in Berlin, which we will describe below. There is nothing new in building balloons of metal, and the idea has already brought forth a considerable literature.

The first unsuccessful attempt took place in Paris in 1843, at the instigation of Marey Monge, by the aeronaut, Dupuis-Delcourt. They built a spherical balloon of sheet brass, of 10m. diameter, which, owing to its weight, could not rise.

The Berlin balloon was invented by the Austrian, David Schwarz, of Agram, and built at the expense of Mr. Carl Berg, in Ludenscheid (Westphalia), who also carried out the calculations and the construction of the vessel with the help of his engineers, Weispfennig and V. Watzesch.

and rigidly connected with the same by means of latticed supports. The body of the balloon

was 47.5m. (157 ft.) long, and had an elliptical section of 14m. and 12m. (46 and 39 ft.) axis length, with 132 sq. m. (1,452 sq. ft.) air resistance. The capacity equalled 3,697 cubic m. (130,500 cubic ft.), so that it is the largest airship hitherto built. The balloon was furnished with a four cylinder Daimler benzine motor, of 16 indicated, 12 effective, horse



The shape is as shown in the illustration. The body of the balloon consisted of a framework, which was covered with sheet aluminium 0.2 of a millimetre thick. The bottom of the car was 4.5m. (15 ft.) distant from the balloon,

power. The aluminium propellers had a comparatively small diameter. The two propellers at the sides of the body of the balloon measured only 2m. (6½ ft.), that in the middle, over the car, the shiftable steering propeller, 2.75m. (9 ft.) high; and below the car bottom, in addition, was a horizontal screw, which was not brought into requisition during the trial. The total weight (load) of the balloon was about 3,560 kg. (7,832 lbs.). The whole exhibited a masterpiece of German aluminium work. In filling it with gas, after the building in the beginning of 189/ was finished, some difficulties were at first encountered. Marey Monge, as is known, tried three methods during his trials, viz:

(A) Filling with water, and letting in the gas; only possible in practice with quite small vessels.

(B) Placing a stuff balloon inside the metal balloon, which becomes filled, and remains inside.

(C) Filling with gas through a tube which reaches up to the highest point in the balloon, pressing out the air by the lighter gas.

The latter process was used on this occasion. (See Zeitscrift fur Luftschiffahrt, 1885, p. 155.) On two occasions Schwarz failed in filling the balloon. Once the gas was not buoyant enough owing to mixture with air. The next time, through a tear from an unknown cause, the gas had escaped. The filling on November 2 was accomplished in 3½ hours.

With respect to the closeness of the balloon, trials in the factory had shown that even with 2½ atmospheres water pressure on the rivet seams, not an atom of water passed through. The loss of gas, therefore, on the following morning, notwithstanding the many thousands of rivet places, was hardly worth mentioning. They wished to have calm weather for the first trial, and thought they could count upon such from the state of the weather on November 2nd, when a high maximum was spreading over Europe.

Nevertheless, on the afternoon of November 3rd, a tolerably fresh wind, E.S.E., sprang up. The anemometer on the balloon establishment showed a steady pressure of 7.5m. per sec. (19 miles per hour). Notwithstanding this, the balloon was towed out of the hall, held by cables, on to the Tempelhofer field, and placed head to the wind. The aeronaut, Jagels, had mounted into the car, and at once

set the motor in motion. Various eye-witnesses informed us that, in fact, the vessel drove forwards, against the somewhat fresh breeze.

As they intended only to try a first experiment, they held it at first by ropes. The ropes broke one after another, and the vessel became free. As Jagels noticed his situation, he set the machine to a higher speed. Soon after his right hand propeller belt came off its wheel. The vessel in consequence turned 1¾ round on its axis, and was driven back by the wind. Over the barracks of the Railway Regiment No. 2, it seemed again to stand against the wind, just as the left propeller band was also blown off the wheel.

The rudder screw, which now alone remained, seemed not able by itself to overcome the resistance. When at last the band came off the rudder screw, too, the aeronaut opened

the valve, in order to land as near as possible to Schoneberg, over which place he was being driven.

He checked his rapid descent by throwing out sufficient ballast, and bounded up twice, which proved the strength of the framework, whilst the covering suffered tears, through which the gas escaped. At the third bump the balloon was thrown on its side on a hill, covered with bushes, between Wilmersdorf and Schoneberg, and remained so.

The stranded apparatus was eventually (with the exception of the framework) reduced to a complete wreck (Fig. 3), partly by the crowd which hurried round, pulling at it, and by the strong wind prevailing during the night of the 4th and 5th.

The trial, in fact, showed no decisive success, but gave a whole series of positive results, which must in every respect encourage procedure in working on in the given direction.

Success is exhibited in the sole fact that it has proved possible to construct, closely and strongly, a rigid riveted metal balloon weighing 3,565 kg., and of 3,697 cubic m. capacity, which could be sent up, and be driven forwards against a comparatively fresh breeze, even if only for a short time, in consequence of adverse circumstances.

Flight, and how Birds get a Rise out of the Wind when Soaring.

By G. L. O. Davidson.

This question has been so much discussed within the last few years, and so many are daily observing and studying the flight of every specimen of bird, that it is somewhat astonishing to me I have not yet come across any mention of the method which to my mind accounts for all the wonderful, and, to other theories, apparently impossible results of the ways of an eagle in air. I should be very glad to hear what objections can be raised to my explanation of how soaring is accomplished by any or all of the numerous writers and thinkers whose marvellous mathematical calculations enable them to account for some of the manœuvres of birds to their own satisfaction. I have not yet seen any description of a theory which claims to account for every movement of all birds, but it must be admitted if any theory falls short of that, it cannot be correct; whilst if it fulfils that condition it cannot be very far wrong. It sounds rather a large order to state that, having studied the subject of flight for 16 years, and observed the flight of many and various birds, I have never seen a single evolution or movement of a bird which my present knowledge of the laws of flight does not enable me to account for, and see, at any rate to my own satisfaction, how simply and naturally it is accomplished by the birds complying with those laws. It is another matter to successfully explain on paper the conclusion at which I have arrived, and as it would perhaps require more than a short essay to describe and account for the wonderful feats of active as well as passive flight, apparently at variance with the generally accepted rules laid down by students of volation, I merely propose to confine myself in this paper to "soaring," or what I have termed "passive flight." I do not think it has been so designated before.

I will now attempt to exemplify my theory by endeavouring to give a lucid explanation of one only of the feats referred to by Mr. Chanute in the "Aeronautical Annual" for 1897, pages 119 and 120, which he describes as "more difficult to account for," and I assert as a fact that the gull in accomplishing that particular feat, viz., rising higher than the starting point without flapping, extracted every particle of extra lift from a horizontal wind by the action of that wind upon the rear part of the wing curved downward beyond the angle of the line of direction in which the gull was cutting through the air, namely, the line made by the forward part of the curve of the wing and the tail. I would then say that I discard all ideas as to the necessity for birds taking advantage of any upward trend of the wind, and remark, that if a bird cannot rise in a wind which is not absolutely blowing downwards, it is not likely to be very proficient at soaring even if the wind is blowing upwards; and I therefore take the horizontal as a basis for the general condition of the wind in describing the action of soaring birds. Taking, then, the instance as given by Mr. Chanute of the gull perched upon a pile-head, 10 ft. above the water, facing a wind, which is described as blowing horizontally, at the rate of from 9 to 15 miles an hour. The gull, so it is said, opened his wings wide, took advantage of the greater speed of a wind gust, rose upward without beat of wing two or three feet, and travelling backwards a few feet, descended almost vertically about 9 ft.; then taking a forward movement, it rose again

12 ft., or say 3 ft. above the point to which it had risen on leaving the pile head, or a total rise of some 6 ft. without a beat of the wing.

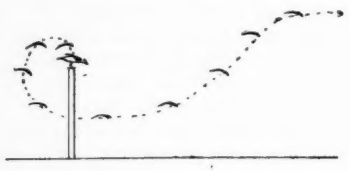


FIG. 1.—What Mr. Chanute describes as appeared to be the path of the gull over the water.

FIG. 2.—The course the bird must have taken through the air.

Mr. Chanute does not seem to me to have taken into account the fact of the air passing the point of observation, as well as passing the pile-head, thus making a difference between the true Fig. 2 and the apparent path of the bird through that air, Fig. 1. Another fact which I think Mr. Chanute has not reckoned upon, namely, that owing to the bird being perched upon the pile-head with its wings opened wide to the wind, it was, at the moment of leaving the pile-head, travelling through that air at whatever speed the wind was blowing, and thus had velocity with which to travel in an upward curve through the air, the fact of this velocity being not greater than the pace of the wind makes the bird travel backwards over the water, but all the time it is going forwards through the air slower and slower, until the velocity is nearly expended, and it then alters the angle of inclination by turning down its tail, and glides down an inclined curve, gathering speed as the force of gravity takes effect; but there again in the downward curve it appears still to travel backwards until it has regained a velocity equal to that at which the air is passing over the earth or water; then it appears to sink vertically until its velocity exceeds that of the wind, when it goes forward faster and faster, until, having as much way on as it desires, it again, by turning its tail upwards, commences another upward curve, which is continued if it so wishes until the force gathered from gravity in the downward glide is nearly expended. How is it, then, that the bird "soars," or without flapping, rises higher than the point from which it commenced to gather force by gliding downwards? It certainly is very difficult for any bird to do so in still air, nor do birds, except those with very much curved wings, attempt soaring in calm air, and it is admitted that the air is never absolutely at rest. If a bird could overcome gravity, not to mention the friction, (which, although all admit it is quite a small item in the air, yet it is an item which must be reckoned with), and, overcoming gravity, rise higher than the starting point without any lifting help from the force of the movement of the particles of the air, or without depending on any other force but gravity alone, it would, as someone has said, be a form of perpetual motion, and that, we know, is absurd; therefore the increase in rise must be got from the force of the wind, and to be of any practical value to a bird it must be got when it wants it, and consequently it must be able to depend upon a horizontal wind, or at any rate one which does not invariably blow downwards, and it certainly must not be dependent only on upward gusts. I therefore maintain that, by the fact of any wind catching the under and back part of the "sousface" of a curve projected against it, which it can only do when the back part of the curve of the wing is inclined slightly downwards, an enormous vertical lift is obtained without appreciably or proportionately retarding the speed of the projected curve, the point of inertia being near the forward cutting edge, and as also it is a fact that any wind, horizontal or otherwise, striking the convex surface of a curve when gliding downwards with the forward part inclined downwards, does not give any appreciable downward vertical push, nor proportionately retard the speed of the downward glide, so are the birds, by the difference between these two facts, able to take advantage of this vertical lift from the horizontal wind during their upward curve, and get a rise out of the wind without being affected by any corresponding hindrance in their downward glide, and without in any way altering the method of obtaining forward motion in calm or wind, which is done simply and solely by taking advantage of gravity, and using the force gathered by the downward glide, till it is expended by gravity and friction, should an upward or horizontal course then be taken, lifting being obtained in calm by the action of wings, and in wind either by the action of the wings or by extracting the lift from that wind as de-

scribed above, whilst starting in face of a wind is equal to having obtained in calm, by a downward glide, the same velocity as that of the wind the moment of starting.

FIG. 3.

The above rough diagram (Fig. 3) may give an idea of how the horizontal wind has no appreciable downward push during the downward glide upon any part of the aerocurve, whilst it may easily be seen how effectively a horizontal wind may act upon the hinder part during the upward projection, provided always that the point which gathers the momentum in the downward glide, and thus by its weight drags forward the whole structure in the upward curve; in other words, the point of inertia is towards the forward part of the actual aerocurve, the hind part of the aerocurve, upon which the horizontal wind has a lifting effect, because it projects from the cutting line of direction, being thus forced over the air, and not allowed to cut through it. I would here suggest how difficult it would be to control the direction of the structure in attempting to carry out this action by means of force from behind, such as propellers, with a push instead of a drag, or in any case where the heavy and active part has to follow the light cutting edge. Very little attention appears to me to have been given to the functions of the tail of birds, and yet we cannot help seeing that it is a very necessary part of the animal. In fact, I have held for the last 16 years, and still maintain more than ever, that the proper action of the tail is the main, if not the only means, of governing the angle of inclination of the outspread sustaining and cutting surface of the bird's wings, not to mention direction, with which the tail has a great deal to do. What appears at first sight simple, namely, the alteration of the centre of gravity, as in the case of the attempts of Lilienthal, Chanute, Pilcher, and others, at soaring flight, is, in my opinion, a most complicated and dangerous manner of preserving equilibrium, and, as far as I can gather, no one but myself has ever attempted the construction of any structure in which a properly controlled and properly constructed horizontal tail, governed automatically, is one of the essential parts. I leave to others to endeavour to calculate to a nicety the exact amount of lifting power to be derived from the wind by a bird of given weight falling with an estimated velocity at such and such an angle, against a wind blowing at a given speed, the wing of the bird having a curve of so many degrees, and I content myself with the fact that from observation I know that birds are able to gather more than ample force by allowing the weight of their bodies, supported by an aerocurve from a vertical fall, to glide downwards through the air, the convexity of the aerocurve offering so little resistance in the downward glide that the momentum accumulated in the body enables this body, which itself offers no more resistance to forward movement in the upward than it does in the downward glide, to drag the aerocurve forward through and over the air, and in such a position that the hind part is caught and blown upwards by the horizontal wind so long as it continues to travel in the face of that wind. I am convinced, also, from observation, that the soaring bird, although never flapping its wings, does straighten the hinder part in the downward glide, thus offering little or no resistance to the air when it is gathering the force of gravity, and in the upward motion it curves the hinder part out of the line of direction, and thus obtains the increased lift from the horizontal wind, which, catching that curve, blows the whole body upwards so long as gravity allows the forward motion through the air to continue.

FIG. 4.

I attempt to show this in Fig. 4, another rough illustration which I think will be admitted to be in accordance with what may be any day observed. No doubt in years to come we shall have beautifully-constructed soaring cars, which may be employed for flying races up to some great height and down again, and where skill and practice will tell and win the race, but for practical travelling by air we must confine ourselves just at first to obtaining our lift mainly by means of a rotary substitute for the flap of such birds as the crow, and I absolutely disagree with those who hope to get practical results in flight with a run or a jump and a flimsy structure of bamboo,

wire, and canvas, although the data furnished by these workers towards the solution of the problem of flight must be admitted to be most valuable.

A more simple explanation of soaring I will endeavour to give in fewer words. As Mr. Chanute points out, all soaring birds have considerable curve in the wing, and he "is constrained to believe that birds of certain types do extract energy from horizontal winds." I say most emphatically that they do, and no one can satisfactorily account for soaring upon the assumption that there must be an upward trend in the wind whenever and wherever the millions of soaring birds daily and hourly desire to rise. Are all these soaring birds to seek out, according to Mr. Maxim, the ascending columns of air, and recognize them through their sensitive air cells, although these columns are generally, so he says, from 500 ft. to 20 miles apart? This sort of argument sounds to me very chimerical. I therefore repeat that all birds with a well-curved wing are able to extract an enormous amount of lifting power from a horizontal wind, even from a breeze of not more than four to five miles an hour, and in this way:—

1. The whole force for forward motion through the air by birds is obtained from gravity acting upon the weight of the body.

2. The body is formed to glide through the air with the least possible amount of friction, and no cutting surface but its point.

3. The path of the whole structure through the air is mainly governed by the tail acting as a horizontal rudder, hinged at D, Fig. 5.

4. The body is supported from a vertical fall by the air surface passed over by the outspread aerocurves or wings, the momentum of the body dragging the whole structure through the air, over a large surface, the weight of the body being balanced and supported at about the point A, Fig. 5. And here I may add that the larger the structure the smaller the proportion of air which will escape, and consequently the greater the weight which each square foot of air surface passed over will support.

5. The forward half section of the wings and tail are always in the line of the direction EE, Fig. 5, in which the bird cuts through the air.

6. The rear part of the wing curves downwards below the line of the direction of the cut through the air of the body, the forward part of the supporting aerocurves, and tail, and thus comes in contact with, and must be dragged over, the air coming from the direction of C, Fig. 5, and this curve is not allowed to cut through the air; consequently great pressure is created at point B, and causes a vertical lift affecting the whole structure, and thus gives the bird an upward line of flight, FF, Fig. 5, at a different angle from its line of cutting through the air.

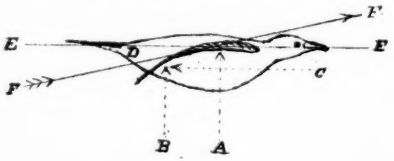


Fig. 5.

If the curve of the wing is great, as in the case of the hawk, the bird may continue to extract a considerable lift from the wind, or, in other words, be blown upwards by a horizontal wind, even when the direction of cut of the forward part of the wing and the tail EE is inclined downwards, and the bird thus retains its momentum by still being on a downward glide as regards its centre of gravity, although the horizontal wind is at the same time pressing it up and up on to different strata of air by the lift at B. It is thus a hawk hovers, it is thus soaring birds soar, and although my attempt at describing the theory may be faulty, and my explanations may be criticised, I am convinced the principle cannot be denied; and I should like to hear what mathematicians can make of it, for I feel sure many of those whose calculations I have read will be able to sit down and calculate the power extracted from the wind in this manner, right off the reel, although if they will insist upon relying upon wing square surface formulas, I think their calculations will probably be most misleading, and I would suggest that they pay a little more attention to the size and extent of the effective cutting edge of the aerocurves as being more reliable in practical volation; for, if the tip to tip measurement of a pair of wings be 10 ft., and their surface 20 sq. ft. or 40 sq. ft., they will only pass over the exact same square surface of air in the same time, say, 100 sq. ft. cutting through it at the rate of 10 ft. a second, and the 40 sq. ft. will give no more support than the 20 sq. ft., except for steadiness of flight.

As a cutting surface formula this may be a startler. The figures of the assumed first-named weight and dimensions may not be strictly accurate, nor can I explain what scientific principle is involved in the fact that the larger the structure the smaller the area of

air surface required to support each lb. of weight, and that there is no apparent fixed figure of necessary square surface per lb. weight, either for the wings of a bird or the area of air which must be passed over to support that weight, except the theory which I have already stated as to the larger the proportion of air which does not escape, the greater the weight it will bear per square foot; and I now state as one of the laws we must go by, that the air will support structures of a certain design (the design of a bird) up to any size and weight, so long as the structural (lineal, square, and cubic) dimensions are kept proportionate, the specific gravity of the whole being retained, and the action of the structure upon the air also remain proportionate, I mean as to speed. Upon this law it will be found, and I challenge anyone to disprove it in the fact, for the birds, which are as yet the only practical models by which we can calculate, will prove it, that, presuming the albatross has a cutting edge of, say, 10 ft., weighs about 20 lbs., and is supported when travelling over air at the rate of, say, 7 ft. per second; then, with a $2\frac{1}{2}$ times greater in extent cutting edge, or 25 ft. tip to tip, and with a proportionate breadth, making the area equal to the square of $2\frac{1}{2}$ times that of the area of the albatross (if you like, for the sake of stability), this structure will, if you increase the speed $2\frac{1}{2}$ times as well, support the cube of $2\frac{1}{2}$ times the weight of the albatross, or some $312\frac{1}{2}$ lbs., although the surface passed over per second per lb. weight of the albatross figures out 3.25 sq. ft., whilst that of the larger structure figures out 1.4 sq. ft. of air surface passed over per second per lb. weight supported. We may form an idea of the capabilities of the larger structure for ourselves, even from the imperfect data furnished by the gliding machines already experimented with, and I distinctly state that a properly constructed aerocurve having a cutting edge ten times that of the albatross, or 100 ft. from tip to tip, passing over the air ten times the speed, or 70 ft. per second (about 50 miles an hour), will support a total weight of 1000 times that of the albatross, say 20,000 lbs., or 10 tons American. When this is admitted, despite the fact that it would only require .35 of a sq. ft. of air surface passed over per second per lb. supported, it will show what I have for many years contended, that it is no good trying to make too small a machine, and that to get satisfactory results we must go to such a size that we can afford to be clumsy, and have the requisite intelligence contained in the machine in the form of a human being whose weight of say, 150 lbs., is only a small item in a machine weighing 10 tons, but is proportionately enormous in a glider capable of raising only 300 lbs.

No doubt mathematicians will at once say in reply to these calculations that if we only go big enough the air will support almost any weight, and so it will, if the moving structure could be made in such a form that none of the particles of air could escape from beneath it, and the fact that the larger the air surface passed over, the less chance there is of the central particles of air being disturbed or escaping will, I think, be admitted to be a valid reason why those particles will give such a support under those conditions. What we therefore have to get at is the minimum speed required in practice to support each lb. weight by an aerocurve of a suitable form of given dimensions, and then we can rely upon it that with the same form and proportionately increased dimensions and speed, we get an equal support per cubic foot of bulk, which is the same thing as multiplying the weight by the cube of the increase in lineal dimensions. I have on various occasions heard it remarked that we cannot get away from the fact that for the same strength of structure we must increase the weight by the cube, in which case, if there be a fixed weight that each square foot of aerocurve surface will support, irrespective of the size of the structure, we could not provide supporting square surface for this enormous increase of weight in constructing a large machine. I therefore maintain that the weight which each square foot of surface will support increases also as the cube of the increase in dimensions, and that not only can we construct the outspread surface with material of sufficient strength, and yet keep within the proportionate weight of the bird's wing bulk for bulk, but that in constructing the body part we have such an increase in margin the bigger we make the machine, that we shall have ample room for engines of greater proportionate power than the internal power of birds, as well as room for human beings and reasonable freight. As I said at the commencement of this paper, I intended to confine myself to soaring, or passive flight, so will it be seen that all these calculations are within that category, for this 10-ton structure I have suggested is supported only at a speed of upwards of 50 miles an hour if it remains passive, and would require a much stronger wind than the gull to enable it to start passive flight from the top of a similar pile head as in Fig. 1. This stronger wind cannot, of course, be relied

upon for practical purposes, and consequently, although we may be able to construct a large machine which will continue in passive flight when once it is started, provided the speed of the wind by which it is able to soar, is to the velocity at which the gull is travelling through the air, in the same proportion as the speed of the wind which enables the gull to soar is to the velocity at which the gull is travelling through the air, it is not likely that the wind will often blow with sufficient force to allow a ten ton air car to start, or having started, to continue merely in passive flight. We must therefore consider carefully the conditions of flight in calm, and obtain an efficient substitute for the action of the wings of birds when starting in a calm, to enable us to start a 10-ton car in anything but a high wind. I have made calculations, based upon Nature's laws of flight, as I see them, which enable me confidently to state that it will be neither impracticable, nor even difficult, to so construct and work the larger air cars that they by their own power may rise in an absolute calm, and also descend and stop at any suitable place, whether the wind blows or not, and without any unnecessary or uncomfortable collision with the ground, for although, as is well known, the larger birds have much difficulty in starting in a calm, owing to the absence of room to work their widely extended wings, my mechanical substitute, lifting on the same principle, but with the suitable mechanical substitute for the intermittent action of the bird's wings, will not labour under the same disadvantage. One other point about which there is really no difficulty if the laws of flight are understood, and a most essential point it is, namely, the automatic stability of the whole structure. The air car I intend to construct when in funds will not turn turtle. In an ordinary wind it will, by automatic arrangement, glide smoothly and steadily along. I should not, however, be surprised if in heavy gales there may be a good deal of pitching and rolling, with the possible result of a new malady in the form of air sickness. I am now, however, wandering from the point which is the object of this paper, viz., to give a lucid explanation of the theory of passive flight, or how soaring is accomplished, and as I hope I have now made this fairly clear, I will close, trusting that those who admit the truth of my assertions will recognize the fact that I am the first to give expression to this theory, and that they will co-operate with me in my endeavours to continue experiments in this direction, and not take advantage of the new line of thought to which my assertions may give rise, and work it out independently of me. Funds are necessary, considerable funds, so as to carry out practical experiments. Engineering skill is also requisite, and I have great hopes I may be able to combine with others having greater engineering knowledge than myself, taking one man's engine, another man's material, and so on, combining a number of comparatively perfect pieces of mechanism, all acting in accordance and designed to comply with this theory which I have long claimed as mine, viz., that gravitation is the sole force employed by birds for forward movement, a theory which is based upon the laws Nature has laid down for mechanical as well as natural flight.

GEORGE L. O. DAVIDSON.

July 1st, 1897.

Since writing this paper I have (9th August, 1897) only just come across M. Mouillard's simile of the "roller coaster," vide page 158, "Aeronautical Annual," 1897, and find that it quite expresses the views I have held these 16 years. M. Mouillard does not say how the bird extracts the force from the wind which takes the place of the moving roadway. I have endeavoured to do so, but I think he does show in this way most conclusively that the force of the wind may attain the same result as the force of the moving roadway, and that, as the force of the moving roadway can be transferred into the body resting upon it, and give that body motion, so can the force of the wind be utilized by the bird resting upon it, if the bird goes the proper way to work, and is constructed to enable it to perform that work. So also will a mechanical appliance extract force from the wind if constructed in compliance with the requirements of Nature.

Mr. Pollock's Balloon Trip Across the Channel.

By P. SPENCER.

Tuesday morning, October 12, 1897, opened out bright and clear at Eastbourne. At 6 a.m. no clouds obscured a perfectly blue sky, and a gentle breeze blew from the north-west. It was decided that the conditions were favourable for a balloon voyage to France. The grounds of Devonshire Park had been kindly placed at our disposal by Mr. A. Standen Triggs, Managing Director. The balloon had

been prepared for inflation overnight, and arrangements made with the Eastbourne Gas Company to be in readiness to turn on the gas if desired. This was done at 7 a.m., and the inflation proceeded satisfactorily until the balloon was full at 9 o'clock. The balloon had a cubic capacity of 35,000 ft., was nearly new, having previously ascended on six occasions only at the Crystal Palace, at Shrewsbury, and at Reading. These ascents had all seasoned the balloon, and a recent coat of varnish had rendered it gas-tight and in good condition. On the present occasion a small car, such as that usually used with balloons of 25,000 cubic feet capacity, was used to save weight. A trail rope of 250 ft. in length, weighing 80 lbs., was carried; a conical waterproof bag to act as a drag or sea anchor if required, and a Board of Trade cork life belt was in the car. Beyond these there were no further accessories than are usually provided with Messrs. Spencer and Sons balloons. Shortly before 10 a.m. the balloon was quite ready to ascend. The north-west breeze continued without abatement, and there seemed every prospect of a pleasant trip. It was found that the balloon would carry 14 bags of sand, with a total weight of 7 cwt., in addition to Mr. Pollock's weight, and even then have a satisfactory surplus of lifting power, say some 60 or 70 lbs. Mr. Pollock was provided with an aneroid barometer, with an altitude scale registering up to 20,000 ft., and one of Messrs. Phillips and Sons' maps of the English Channel. He also took with him a small handbag with personal requirements, in the event of his being obliged to stay for any time abroad, and a parcel of sandwiches and a bottle of claret. He took his seat in the car, and the balloon was released, and sailed aloft in the brilliant sunshine. It made a course almost directly towards the sun, which was then in the south-east. It was noticed never to bear to the west of the sun, but continued its course until about 11 a.m., when it was lost to sight of those who watched it from the sea front. I am now able to give the following particulars as told me by Mr. Pollock, from notes taken by him at the time. The balloon ascended at a uniform speed until an altitude of 4,000 ft. had been reached at 10.15. For the next half hour a grand view was discernible. The sun shone brilliantly, and the white cliff of Beachy Head stood prominent, and formed a land mark which easily permitted the bearings of the balloon's course across the sea to be taken with the assistance of the compass. For some half an hour the 4,000-ft. altitude was maintained, when the balloon began to descend, which necessitated the first sacrifice of ballast. Half a bag was thrown out at 11 a.m., when the balloon had descended to 1,700 ft. above the sea. At 12 o'clock the altitude was 3,300 ft., the balloon slowly rising, and at 12.10 the English coast had disappeared, though Mr. Pollock believes that he afterwards saw the white cliff of Beachy Head an hour later. At 12.45 the balloon had reached an altitude of 5,000 ft., and some marvellous cloud effects were visible. At 1.30 the French coast came in sight, and at 20 minutes to 2 it was noticed that the balloon was descending a second time. At 10 minutes to 2 the trail rope, which hung for 250 ft. below, touched the water. This enabled the course of the balloon to be checked by the compass. The ballast discharged caused the balloon to lift the trail rope out of the water, and at 2 o'clock the balloon had again reached an altitude of 4,500 ft., and was still rising. At 2.7 it was 6,000 ft. high, and at 2.12 7,000 ft., at which height the atmosphere was chilly. At 2.17 the balloon was 7,500 ft. high, and at 2.30 8,000 ft., at which height the windings of the French coast were visible for many miles. The bar of the river Somme was crossed at St. Valery, so that from coast to coast the trip across the Channel had occupied exactly 4½ hours. Between 2.30 and 4.30 the balloon passed across the French country, and eventually descended in a suitable ploughed field, the nearest town being Domart, which is 95 miles from Eastbourne in a direct line, and 25 miles from the French sea coast, the cross Channel distance being 70 miles. The average speed at which the balloon had travelled was therefore 15 miles per hour. Seven bags of ballast were left at the descent out of the 14 taken, so that there was an ample margin of carrying power in the balloon, which would have enabled the journey to be continued further overland had it been so desired.

Mr. Pollock was provided with English gold, but found that he should have exchanged it for French money before starting, in order to be provided with coin current in the country districts at the descent. He had, however, but little difficulty as to assistance, and shortly obtained a vehicle to convey the deflated and packed-up balloon to the St. Leger Station on the Chemin de Fer du Nord, where he booked to Calais, and crossed by the night mail boat to Dover, arriving at Victoria at 5.40 the next morning.

PERCIVAL SPENCER.

14, Ringcroft Street,
Holloway, London, N.

NOTES.

THE HIGHEST KITE ASCENT.—The general interest in scientific kite-flying leads me to send the following account of a flight here on September 19th, when meteorological records were brought down from the greatest height which it is believed a kite has yet attained. The experiment was part of an investigation into the meteorological conditions of the free air now in progress here, and which is aided by a grant from the Hodgkins Fund of the Smithsonian Institution.

A Richard baro-thermo-hygro-graph (described in "La Nature," 8 Fevrier, 1896), weighing but 3 lbs., was hung 130 feet below two large Hargrave kites, and other kites were attached at intervals to the four miles of steel wire forming the flying line, the total sustaining surface of the seven Hargrave kites used being something over 200 square feet. At their highest position the two topmost kites were 9,386 feet above Blue Hill, or 10,016 feet above sea-level. The altitudes, at short intervals of time, were obtained from angular measurements with a theodolite, and were confirmed by the barometer record of the meteorograph.

This instrument left the ground about noon, and the greatest height was reached soon after four o'clock, the meteorograph remaining more than a mile above the hill during five hours. A little more than two hours were required for the steam-winch to reel in the four miles of wire, and the meteorograph returned to the ground at 6.40 p.m. The wind on the hill blew from the south with a velocity of about twenty-five miles an hour, but veered to the west in an upper air. The chief results, obtained from the automatic records, which are smooth and distinct, are these: — The temperature at the highest point was 38 degs. while at the ground at the same time it was 63 degs., giving a decrease of 1 deg. per 375 feet rise, which is less than normal. The relative humidity at the ground was about 60 per cent. of saturation, but rose rapidly with height to about 4000 feet, which is the level of the cumulus clouds. It then fell, but rose again to nearly saturation above 7,000 feet, when approaching the level of the alto-cumulus clouds. The humidity fell to less than 20 per cent. at the highest point reached. Throughout the flight the sky was clear.

A. LAWRENCE ROTCH.

Blue Hill Meteorological Observatory,
September 23rd.

The highest kite ascent, described in "Nature" of October 7th, was in turn exceeded here by more than 1,800 feet on October 15th, when excellent meteorological traces (of which a facsimile is enclosed) were brought down from a height of 11,086 feet above Blue Hill. The flight was affected with only four kites, and the ascent and descent occupied but four and a half hours. Excepting a more rapid decrease of temperature with increase of elevation, the results agree with those already stated for the previous high flight.

I now desire to call attention to the fact that the deductions from our automatic records obtained with kites seem to confirm, in general, the conclusions reached by Messrs. Welsh and Glaisher from their observations in free balloons many years ago in England. For example, we find also that the most rapid decrease of temperature with height occurs usually in the lower mile of air during the daytime, and, even with no visible clouds that damp strata often exist in the dry air of the upper regions. A discussion by Mr. Clayton of more than one hundred meteorological records, obtained with kites since 1894, is now in the Press, and will form an appendix to Part i., vol. xlii. of the "Annals of the Astronomical Observatory of Harvard College."

A curious illustration of how identical methods sometimes may serve diametrically opposed investigations, is the application of the deep-sea sounding apparatus of Sir William Thomson (now Lord Kelvin) to bring down these aerial soundings.

A. LAWRENCE ROTCH.

Blue Hill Meteorological Observatory,
November 1st.

—*Nature.*

A PARADOXICAL DESIGN.—We have received from Mr. Alex. Adams, Assoc.M.Inst.C.E., of Sydney, New South Wales, a printed paper with reference to "Mechanical Flight." The author states that if a machine be constructed with beating wings, "it's flight may be indefinitely prolonged." He then adds: "Man, however, does not possess anything like sufficient muscular power to operate 'loaded' wings of 80 or 90 feet area." A diagram is given of an apparatus which is worked "without any exertion on the part of the occupant," and yet "no steam, electric, or other engine is required." We must own that we fail to understand the principle from the description given. It is stated that "the wings are free to elevate or depress with ease at the will of the operator, the action being from the feet off the shoulders." "Pneumatic pressure" is re-

ferred to, and it is added, " with such a device, a man can ' strike ' the down-stroke with a force approaching a horse power."

KITES AND ATMOSPHERIC ELECTRICITY.—Lieut.-Col. Baudoin, writing in the " Bulletin de la Societe des Agriculteurs de France on "the Function of Electricity in Atmospheric Phenomena," brings forward the theory that clouds are formed of minute bubbles of water, or hollow drops formed by the electrical action of the atmosphere. This, he thinks, is partly proved by the fact that rainbows are never formed by clouds alone, but only by rain. He then describes how in China a large number of kites are periodically flown, and thinks that they, though usually regarded as playthings, have in reality the important object of bringing on rain. The kite strings are supposed to convey the electricity with which the clouds are charged to the ground, and the electrified bubbles then become drops of water and fall by gravity. He then mentions some experiments conducted in Tunis with a kite 10 ft. high, which caused a fall of rain each time it was flown. In 1894, a large kite was flown at Courbevoic, when a large cloud, estimated to be about 4,260 ft. high, came in contact with it. The whole cloud descended, forming a cone, and came to earth like a fog. On the kite being drawn down the cloud ascended again.

BENNETT'S APPARATUS FOR BALLOON STEERING.—A great deal has appeared in the papers about an old idea recently revived, of placing various screw propellers, to be rotated by manual power, about the car of an ordinary balloon. It has, however, been frequently demonstrated both theoretically and practically, that such a device is quite incapable of propelling a balloon at anything but a very slow rate, and as for causing a rise or fall, even if proved to be of use in this respect for practical purposes, a few bags of ballast are more simple and efficient. This apparatus has been on view at the Crystal Palace for some time past, but the actual demonstration has been postponed awaiting favourable weather.

LECTURES ON FLYING MACHINES.—Two lectures have recently been delivered, one by Mr. G. F. Charnock, head of the Engineering Department of the Bradford Technical College, before the Bradford Scientific Society, the second at the Hartley Institution by Dr. C. E. Cullis, M.A.

DAVIDSON'S AIR-CAR CONSTRUCTION SYNDICATE, LIMITED.—Registered on October 20th by Ashurst, Morris, and Co., 17, Throgmorton Avenue, E.C., with a capital of £20,000 in £1 shares. Objects: To enter into an agreement with George L. O. Davidson, to manufacture, sell, and deal in aerial or air cars and flying machines, and the parts and fittings of the same, and to carry on the business of mechanical engineers, fitters, founders, wire-drawers, tube makers, etc. The said vendor is the sole governing director. Qualification, 10 shares. Remuneration as the company may decide.

Recent Publications.

Abridgments of Patent Specifications No. 4. Aeronautics, 1884-88, has lately been issued by the Patent Office. This series of abridgments on all subjects, at popular prices (1s.), forms a most desirable aid to the inventor searching to ascertain the novelty of his invention.

The patent laws of this country make no provision for an official search as regards novelty, and all patents are taken out at the risk of the inventors. It is therefore incumbent on any person desiring to obtain a valid patent for an invention either to cause a search to be made, or himself to make a search, as to the novelty of his invention. By omitting such a search, many a patentee has found, after paying his fees, that his treasured patent is worthless, because it has been anticipated. Of course, in this case the first applicant or patentee possesses all the patent rights, and the second one has absolutely no rights at all.

A complete and exhaustive search through published specifications of patents is a task of considerable difficulty, even for the trained expert with all the resources of the Patent Office Library, for at this moment the number of printed specifications of patents is well over a quarter of a million.

A series of indexes and abridgments has been published by the Patent Office as a guide to the specifications themselves, and is freely distributed to the principal public libraries in this country. The abridgments give a general description of the nature of every invention patented, and the object of their publication is to enable the would-be patentee to carry out, at any rate in some cases, what may be termed a *fireside search*. By the study of these abridgments he will generally be able to select certain inventions which have already been patented, and which resemble his own invention sufficiently to render it desirable for him to examine their specifications in detail. A printed copy of any specification can be obtained at an in-

clusive price of 8d., through any Post Office, by a special postcard (Patents Form C'). The abridgments are published in volumes, each volume dealing with one particular class of inventions, such as "Steam Engines," and "Cooking and Kitchen Appliances, &c.," for a period of some years. The volumes up to 1877 are not illustrated, and all the subjects have not yet been dealt with, but from 1877 onwards a systematic series, very fully illustrated, is now in course of publication at a uniform price of one shilling per volume (including inland postage). The volumes for the periods from 1877 to 1883 and from 1884 to 1888 have been completed, those for the periods from 1889 to 1892 and from 1893 to 1896 are in active preparation, and later volumes will follow in due course.

Navigazione Aerea, by G. N. Da Pra (Milan: Ulrico Hoepli), is a small book describing a system of aerial navigation by a screw propelled plane. The general design is very similar to the old Henson machine, but there is also a second design in which there are two planes, like Hargrave's. A benzine motor is also described.

Herr G. Koch sends us an elaborate report on the problem of flight, profusely illustrated with designs and photographs, chiefly refering to his system of feathering paddle-wheels. We propose to fully notice this in our next number.

We have also just received an interesting pamphlet on "Gliding Experiments," by Octave Chanute, a reprint from "Journal Western Society of Engineers," giving a complete and succinct account of his recent experiments, fully illustrated from photographs.

Foreign Aeronautical Publications.

L'AERONAUTE (Paris), *October:* "Aerial Photography by Kite," by Emile Wenz. Illustrated by photographs and diagrams. The advantages and disadvantages of Kites and small balloons for raising a camera are discussed, the only difficulty with the former being caused by lack of wind, the author laying it down that a wind of over 5 metres per second (about 11 miles per hour) is necessary, which, however, is a very high estimate. He then describes different methods of attaching the camera, and arranging the Kites, &c. M. Pesce in a letter discusses various aeronautical terms and considers Prof. Langley's word "Aerodrome" inapplicable in French. M. Nadar has offered his great collection of books, autographs, pictures, &c., relating to Aeronautics to the City of Paris.

November: M. Cailletet writes on apparatus for measuring the heights attained by balloons, and M. Violle on the actimometer. Accounts of several interesting balloon ascents are given, as a result of one of which M. le Cadet thinks that "the intensity of the field of atmospheric electricity diminishes as the height above the ground increases."

December: "The First Aerial Voyage of 24 Hours." Alphabetical Table of Communications published during 1897.

LA FRANCE AERIENNE (Paris), 1—15 *October:* "About dirigible Balloons," by C. Jobert. Signals. American News, "from our special correspondent in New York." "An Aerial Voyage," by Raymond Bouchard.

15—31 *October:* "The Action of the Sun on Balloons," opens up the question of whether light affects the retaining power of the envelope of a balloon. Certainly balloons kept indoors retain their gas longer than those exposed to light and air, also balloon voyages at night generally permit of a longer sojourn in the air; the effect of X-rays on the gas is also discussed. A memoir of M. de la Landelle follows.

1—15 *November:* M. Maret Leriche, honorary president of the Académie d'Aérostation writes "Acta, non Verba." An account is given of the voyage of the "General Chanzy" in 1870. "An Aerial Voyage" is continued. Extracts from Dr. Leon Germe's "Researches on Circulation, Respiration, &c., on Mountains and in Balloons."

16—30 *November:* The Ascent at Leipzig lasting 24 hours. The Voyage of "General Chanzy" is continued; the speed of the journey was nearly eighty miles an hour.

1—15 *December:* "Aeronautics from Day to Day." "An Aerial Voyage," continued. Dirigible Airship, C. de Gregorio. "Departure from Paris during the Siege," Godard.

16—30 *December:* "An Aerial Voyage," continued.

L'AEROPHILE (Paris), *June—July*: "Portraits of Contemporary Aeronauts—M. Frænkel and Lieut. Svedenborg": Lives and Portraits. "The Departure of the Polar Balloon." "The Catastrophe to Dr. Wölfert" (illustrated). "War Balloons" during the

Siege of Paris. "Experiments with a Steam Aeroplane," MM. Tatin and Richet. "Aerial Impressions." "The Third International Launch of Sounding Balloons." "Mr. Langley's Experiments."

August—September—October: "Portraits of Contemporary Aeronauts—M. Ed. Surcouf." "Long Aerial Voyages," discussing the employment of guide-ropes of various forms, sails, and "Mechanical Ballast" (illustrated), "J. P. Blanchard," "Electricity of the Atmosphere." "Apparatus to Measure the Height attained by Balloons," M. L. Cailletet. "Aerial Propulsion in Germany." Accounts of Experiments of Herr Wellner, of M. Sprengel, and W. Kress. "The Aluminium Balloon in Berlin." "Latest Notes of the Andrée Expedition." "The Great Captive Balloon at Leipzig," and the journey of 24 hours. "Crossing the Alps in a Balloon."

ZEITSCHRIFT FUR LUFTSCHIFFAHRT (Berlin), *July—August:* "The Simultaneous Scientific Balloon Ascents of 14th November, 1896." Full accounts, with diagrams, &c. "Fish Tails and Wing Flaps," by A. Samuelson. "The Laws of Elastic Resistance," E. Jacob. "Apparent Motions Behind a Plane Meeting a Wind." "Wind Pressures and Bird Flight," F. Ritter. All the above contain carefully worked out mathematical theories.

September: "Studies in Balloon Material," by Siegsfeld, with methods of testing, &c. "Dr. Wölfert," K. Müllenhoff.

October: "Dr. Leonhard Sohncke," "The Paddle-Wheel Flying Machine," G. Koch (illustrated). "Studies in Balloon Material," continued.

ILLUSTRITE MITTHEILUNGEN FUR LUFTSCHIFFAHRT (Strasburg), *No.* 2—3: "Andrée's Start," with two good photographs. "The History of Balloons for Polar Research," detailing the proposals of Meissel '66, Sivel '72, Cheyre '78, Hermite and Besancon '92, and Andrée '97. "The Action of Wind Currents on Clouds." "The Kite Balloon for Metrological Purposes." "The Flight of Register Balloons." "A Paddle Wheel Flying Machine," G. Koch. "Sport in Ballooning," by H. Moedebuk. "The Founding of a Manufactory for Light Motors and Flying Apparatus," A. Stentzel. "A New Motor," P. Meyer. Notes.

L'AERONAUTA (Milan), *November:* "Construction of Balloons," details of various materials. "Gas Engines." "The Compass in a Balloon." "Aero-dynamics and the Flight of Birds." "The Construction and Use of Balloons of Aluminium and of Brass."

Notable Articles.

Oct. *Science Progress.*—"Artificial Flight." Prof. G. H. BRYAN, F.R.S. An interesting article, including a brief history of the subject, and general discussion on the present position. The author gives the principal requisites as (1) powerful and light motor, (2) propellers and aeroplanes of sufficient lifting power, (3) balance and stability, (4) appliances for steering and controlling, (5) strength and rigidity, (6) means of landing. Each of these subjects is gone into at length.

Le Spectateur Militaire (Paris).—"Free, Captive, and Navigable Balloons."

Deutsche Revue (Stutgart).—"Rarified Air and Ballooning."

1. *English Mechanic.*—"The Aerial Problem." Several letters.
1. *La France Militaire* (Paris).—"Aerostation Militaire." Latest developments.
2. *Daheim* (Leipzig).—"Ballooning in Switzerland." (Illustrated.)
2. *Invention.*—"Polar Ballooning." H. E. HUTCHINS.
5. *Standard.*—"Experiments in Military Ballooning." Letter from D. Archibald, urging the superiority of kites for military work.
7. *Nature.*—"The Highest Kite Ascent." A. L. ROTCH.
9. *Golden Penny.*—"A Sky Bicycle." (Illustrated.)
12. *Daily Graphic.*—"German War Balloon." (Illustrated.)
13. *Times.*—"Military Ballooning." Recent experiments.
14. *Liverpool Post.*—"Military Ballooning."
15. *Engineering.*—"Scientific Ballooning and the High Strata of Our Atmosphere." Full and interesting account of the recent experiments with "sounding" balloons. (Continued in other numbers.)
16. *Revue Scientifique* (Paris).—"Captive Balloons." H. DE GRAFFIGNY. Long article on the history, construction, &c.
21. *Nature.*—"Aeronautical Ascents for Measuring the Electrical Field of the Air."
21. *Nature.*—"On Obtaining Meteorological Records by Means of Kites and Balloons." A. L. ROTCH.
21. *Rocket.*—"Up in a Balloon."
22. *Engineering.*—"Scientific Ballooning," &c. (Continued.)
23. *Black and White.*—"Across the Channel in a Balloon." (3 illustrations.)
25. *Pall Mall Gazette.*—"In High Altitudes." Experiments with kites and balloons.

Nov. *Century Magazine.*—"Andrée's Flight into the Unknown." (Illustrated.)

Scribner's Magazine.—"Aerial Photography." WOGLOM.

Le Spectateur Militaire (Paris).—"Free, Captive, and Navigable Balloons."

Memorial de Ingenieros del Ejercite (Madrid).—"Balloon Ascents."

Journal United Service Institution.—"Note on French War Balloons."

5. *St. James's Budget.*—"Mr. Pollock's Balloon Trip Across the Channel." (Illustrated.)
6. *Weekly Scotsman.*—"Aerial Navigation." Correspondence.
9, 10, 11, & 12. *El Nacional* (Peru).—Four articles on "Aerial Navigation," by J. V. LARRABURE.
13. *Illustrated London News.* "Captive Balloons in the German Army."
15. *Liverpool Daily Post.*—Leading Article, with extracts from *Aeronautical Journal.*
19. *Engineering.*—"Scientific Ballooning," &c. (Continued.)
20. *Illustrated London News.*—"German Aluminium Balloon." (Illustrated.)
20. *Glasgow Weekly Citizen.*—"Balloon Railway." (Illustrated.)
25. *Revue Technique* (Paris).—"Aerostation and Geodesy." M. Cailetet's invention.
26. *St. James's Budget.*—"The New German Aluminium Balloon." (Illustrated.)

Dec. *Atalanta.*—"Military Ballooning."
6. *Nature.*—"The Use of Kites in Weather Prediction."
10. *Engineering.*—"Air Waves, and Their Effect on Balloons."
17. *Dublin Nation.*—"The Battleground of the Future." Discusses the possibilities of aerial warfare.
17. *Daily Chronicle.*—"Soaring Ambitions." General Meeting of the Aeronautical Society.
17. *Morning Post.*—"The Aeronautical Society." General Meeting of the Aeronautical Society.
17. *New York Herald.*—"Aeronauts and Flying Machines." (Illustrated.) General Meeting of the Aeronautical Society.
18. *Daily Graphic.*—"Argonauts of the Air." General Meeting of the Aeronautical Society.
28. *Morning Post.*—"Kites for Forecasts."

Applications for Patents.

23,563. October 13. W. P. S. EDWARDS, 4, Landport Terrace, Southsea. **Improvements in Apparatus for the Navigation and Control of Balloons and Aerial Navigators.**

23,655. October 14. S. E. STATHAM, Manor House, Levenshulme, Manchester. **Improved Means for Preventing the Escape of Fluids from Balloons, &c.**

24,133. October 19. W. J. BREWER, 48, Temple Chambers, London. **Improvements in Aerial Navigators or Steering Balloons.**

24,532. October 22. C. DANILEVSKY, Norfolk House, Victoria Embankment, London. **Improvements in or Connected with Aerostats.**

24,590. October 23. W. DOIG, A. DOIG, and D. DOIG, 174, New Bond Street, London. **Improvements in Balloons and Balloon-supported Cars.**

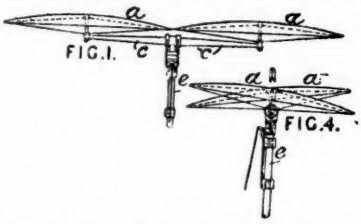
28,810. December 6. E. H. GREY, 261, Essex Road, Islington, London. **A New or Improved Aerial Machine.**

30,932. December 31. W. T. CARTER, Norfolk House, Strand, London. **A New or Improved Method of and Apparatus for Propulsion Specially Applicable for the Propulsion of Torpedoes, Aerostats, and other Bodies Lacking in Stability.**

Patents Published.

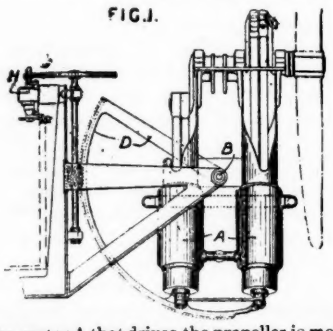
From the *Illustrated Official Journal.*

9,129. April 30, 1896. **Aerial Machines.** KOSCH, R., 60, Centre Street, Cleveland, U.S.A.



For lifting the machine, the propellers shown are employed, and are made large enough to act as aeroplanes to support the machines. Each propeller comprises two wheels *a* constructed like velocipede wheels and covered with balloon fabric in such a way that the air pressure from below curves the fabric into a spherical shape. The wheels are mounted at the ends of arms *c* which revolve about the vertical shaft *e*. When it is desired to raise the machine, the planes of the wheels are inclined to each other by turning the arms *c* about their own axes, Fig. 4, when they act as a screw propeller. When they are to act as an aeroplane, they are turned into the same plane. Two propellers revolving in opposite directions are employed on each machine.

11,995. June 2, 1896. **Aerial Machine** PENNINGTON, E. J., Motor Mills, Coventry.

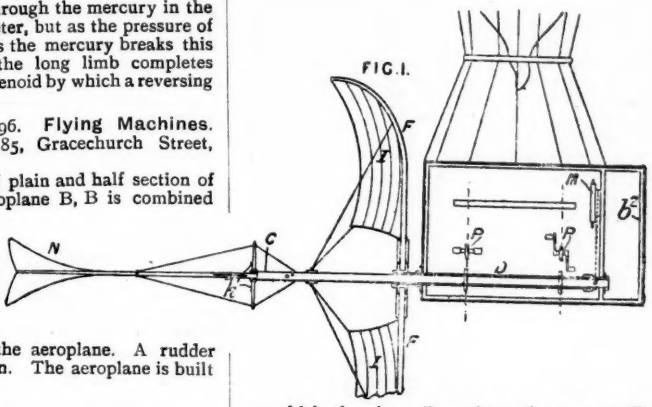


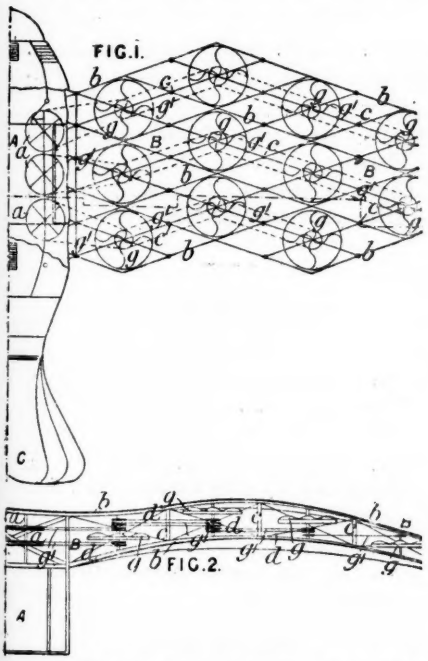
The motor A that drives the propeller is mounted on trunnions B about which it is turned by a toothed quadrant D, actuated by an electromotor H, the current to which is controlled by a baro-

meter, so that the altitude may be automatically regulated. For horizontal steering, the motor may be controlled by a magnetic compass and turned about a vertical axis. The current to the motor H is normally completed through the mercury in the short limb of the barometer, but as the pressure of the atmosphere increases the mercury breaks this current, and rising in the long limb completes another that excites a solenoid by which a reversing switch is operated.

12,469. June 6, 1896. **Flying Machines.** DAVIDSON, G. L. O., 85, Gracechurch Street, London.

The Figures show half plain and half section of the machine. The aeroplane B, B is combined with a motor carried in the car A, and driving fans g, g through pulleys a, a and ropes g^1 g^1. The machine is lifted by the fans and moves horizontally by gliding downwards on the aeroplane. A rudder C is provided at the stern. The aeroplane is built





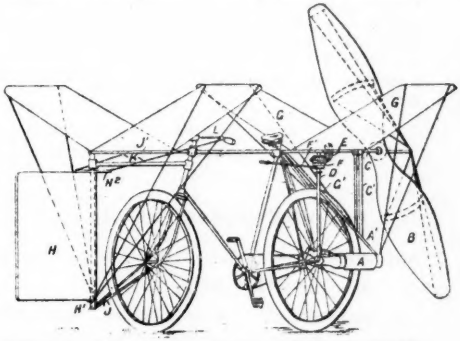
up of T steel b, braced together by verticals c and diagonals d. The surfaces of the aeroplane are covered with network, on which are hinged strips of celluloid or other material, which open as the machine rises and close as it descends.

14,139. June 26, 1896. **Aerial Machines.** JONES, J. and C. F., both of 5, Cyril Road, Small Heath, Birmingham.

Aerial machines supported by aerostats are propelled by propellers F comprising radial arms projecting from a sleeve D and carrying sails I. The sleeve is rotated by pedals P in the car or by a motor carried in the space b^2. Steering is effected by a rudder N pivoted at k, and operated by yoke lines that pass through the hollow rod C, on which the sleeve D works, and are controlled by a wheel M. The machine may be fitted with adjustable aeroplanes to vary the altitude.

17,119. August 1, 1896. **Aeronautical Machines.** E. J. PENNINGTON, Racine, Wisconsin, U.S.A.

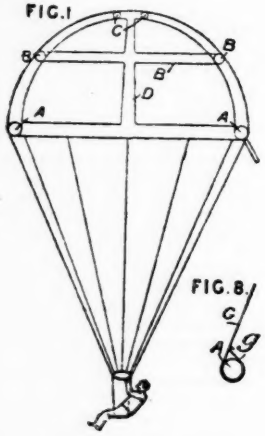
Aeronautical machine comprising a cycle similar to an ordinary road cycle, but driven by an engine applied to rotate a propeller, preferably at the rear end of the machine, in combination with an aeroplane or two or more aeroplanes for raising the machine from the ground, and a rudder for steering the machine. At the rear end of the machine is a propeller B carried by a shaft C which is supported by struts C^1, and is driven by a motor through a vertical shaft D and bevel wheels E. F is a clutch controlled by a handle F^1, by which the shaft C can be thrown in and out of gear when required. The propeller is suitably



stayed by wires B^1. G, G are aeroplanes carried by extensions of the bicycle frame, and suitably stayed by wires G^1. The aeroplanes are shown fixed, but they may be made adjustable, so that their angle of inclination may be changed when desired. H is the rudder for steering the machine; it is mounted to turn on a spindle H^1, which is carried at its lower end by extensions J of the front fork, and at its upper end by the extensions

J^1 of the bicycle frame. H^2 is a crosshead fixed to the rudder, and connected by side rods K to the steering handle L, which is loose on the front fork, and by means of which the position of the rudder is adjusted as required. When the cycle is rapidly propelled in a horizontal direction by the motor which drives the propeller the aeroplanes will operate to raise the machine and rider from the ground. The steering of the cycle is effected by turning the handle bar. In some instances a propeller or propellers in the aeroplane may be arranged to rotate about a vertical or nearly vertical axis to assist in raising the machine.

18,130. August 15, 1896. **Parachutes and Aerostats.** SLY, W. C., 21, Tressillian Crescent, Brockley, Kent.



One or more inflated flexible tubes A, B, C surround the parachute, and ensure its opening when it is released; it may also be provided with similar ribs D and radial arms. Fig. 8 shows the method of fixing the tube to the fabric G of the parachute by means of hooks *g* and eyes. The invention may be applied to the distension of aerostats.

United States Patents.

591,692. October 12. DANIEL REED, Eagle Lake, Minn. **Air Ship.**

A cigar-shaped, inflatable vessel, with car suspended therefrom by pivoted arms; a horizontal transverse shaft, with feathering paddles on the outer ends thereof; a longitudinal shaft at right angles to the counter shaft, with propeller on its outer end.

592,704. October 26. JACOB D. GRAYBILL, New Orleans. **Aerial Machine.**

Comprising a gas-holder, a car located within the framework of said gas-holder. Wings at sides, caused to move similarly to an oar in rowing, having a V-shape in cross-section.

596,231. December 28. JAMES RICHARDSON, New York. **Flying Machine.**

Elongated balloon, a fly-wheel mounted to rotate independently of other machinery, and a motor adapted to drive the same.

French Patents.

(Class VI., 3.)

267,689. June 9. KRAUSS. **Aerial Vehicle Simulating the Form of a Kite Able to Contain a Certain Number of Persons.**

267,801. June 12. RUEZ. **Dirigible Balloon.**

268,311. July 3. HOSDEN. **Dirigible Balloon.**

269,612. August 14. DELAURIER. **Steam Bird.**

250,436. (Certificate of Addition, June 4.) RIEDINGER. **Kite Balloon.**

German Patents.

(Class 77.)

95,178. December 31, 1895. E. J. PENNINGTON, Wisconsin, U.S.A. **Balloon or Aerial Vessel.**

95,914. September 25, 1896. CARL GÖTZKE, Berlin. **Airship with Concave Tail and Aeroplane.**

95,963. April 22, 1896. ALEX. SCHÖRKE, Dresden. **Steerable Aerial Machine without Rudder.**

PUBLISHED.

94,839. CARL EICHLER. **Captive Balloon.**

93,692. ARNIM BECKMANN, Charlottenberg. **Dirigible Balloon.**

93,184. HERMANN ISRAEL, Dresden. **Flying Machine with Perpendicular Acting Wings.**

93,387. T. H. HOMEISTER, Hamburg. **Captive Circular Flying Machine.**